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The Course that Surra runs in Camels when naturally contracted and when artificially inoculated

BY

H. E. CROSS, M.R.C.V.S., D.V.H., A.Sc.

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The Course that Surra runs in Camels when naturally contracted and when artificially inoculated.

[Received for publication on 22nd March 1920.]

I. Naturally contracted Surra.

Many Punjabi camelmen maintain that camels once infected with surra never recover: on the other hand many camelmen state that if a camel infected with surra lasts over three years the camel finally recovers, improves in condition and becomes immune to the disease.

To ascertain the course that surra runs in the camel, 11 camels suffering from surra and in fair condition were obtained from Silladar Camel Corps, some in the latter part of 1914 and some in the early part of 1915. From their condition and history it is probable that these 11 camels contracted surra during the 1914 fly season. Of these 11 camels 9 have died and 2 are still alive. These camels were kept under the most favourable conditions, being given in addition to browsing a ration of grain and *bhoosa*, and when green fodder was available this was substituted for *bhoosa*. The camels were given no work. The blood of each camel was daily examined and a record kept of the presence or absence of trypanosomes. Details of the paroxysms and intervals between the paroxysms, and a history of each camel while under observation is given.

In addition to these 11 camels, seven camels belonging to a villager who lived near Sohawa were diagnosed by me on the 29th September 1913 to be suffering from surra. During the hot weather these camels were not worked and periodical visits were made to ascertain how these camels were "doing." During the cold weather they worked in Amballa and Amritsar Districts. Within $1\frac{1}{2}$ years 2 males had died, and the *dachi* had aborted; within $2\frac{1}{2}$ years 5 out of the 7 had died and in less than 3 years all 7 were dead.

II. Artificially inoculated Surra.

To ascertain whether there is any difference in the course that the disease runs when naturally acquired and when artificially inoculated, four young camels, aged from $2\frac{1}{2}$ months to 1 year and one old camel aged 18 years, were inoculated with 1 c.c. of blood from a camel suffering from surra. These camels were kept under the same conditions as the 11 camels that had naturally contracted surra. The blood was daily

examined and a record of the absence or presence of trypanosomes kept. Details of the paroxysms, and a history of each camel while under observation is given.

I. NATURALLY CONTRACTED SURRA.

CAMEL No. 1.

Aged 6 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st	7	17th	7
2nd	9	18th	9
3rd	56	19th	8
4th	9	20th	19
5th	22	21st	12
6th	12	22nd	6
7th	6	23rd	20
8th	20	24th	43
9th	13	25th	18
10th	7	26th	27
11th	22	27th	188
12th	5	28th	179
13th	2	29th	257
14th	10	30th	135
15th	26	31st	480
16th	8	32nd	
17th			

Died 37 days after the last paroxysm.

Lived 4 years 11 months 20 days after being diagnosed to be infected with surra.

This camel showed more intestinal disturbance than any of the other camels. He had frequent attacks of diarrhoea. He developed oedema of the belly and hind legs, suffered from very severe mange, and was periodically off feed or only feeding slowly; for some time before death took place he had severe diarrhoea.

On *post mortem* nothing abnormal but extreme emaciation.

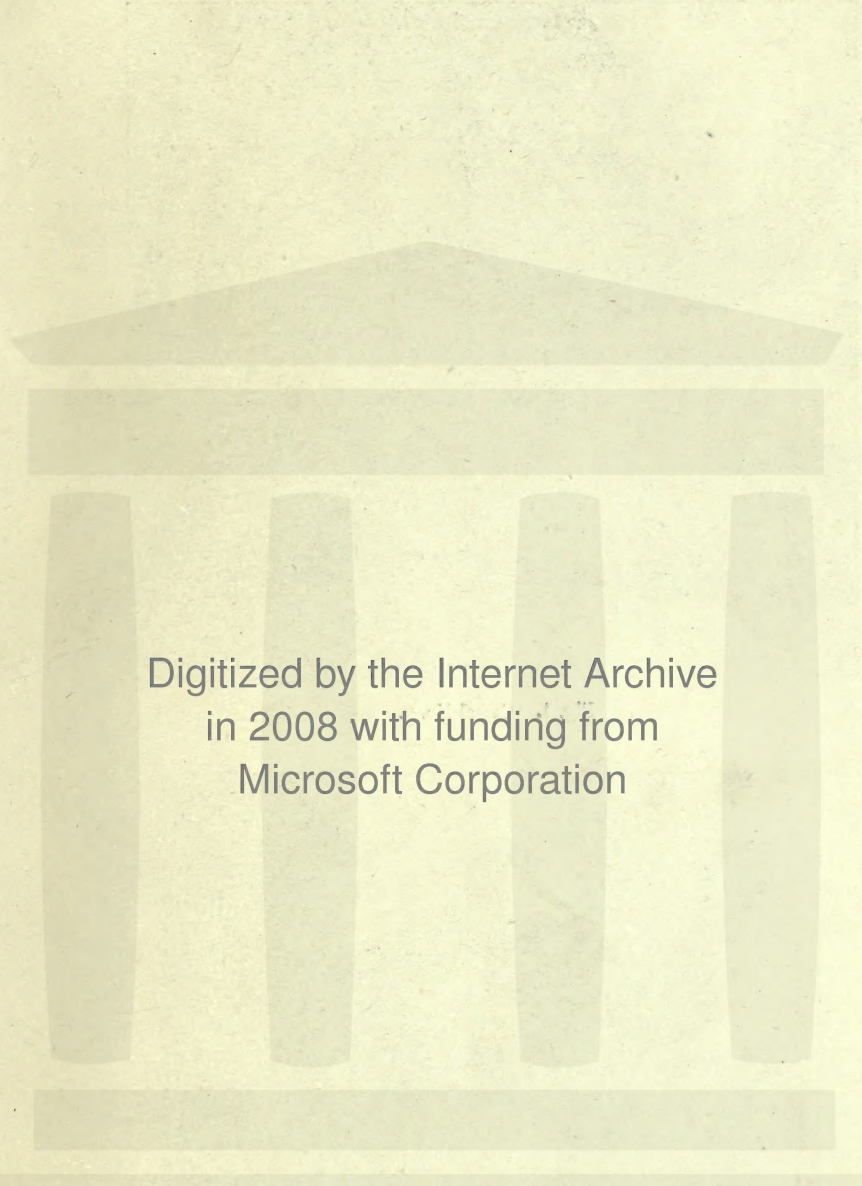
CAMEL No. 2.

Aged 6 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st	5	14th	18
2nd	4	15th	7
3rd	5	16th	13
4th	52	17th	7
5th	10	18th	9
6th	5	19th	6
7th	5	20th	8
8th	28	21st	6
9th	6	22nd	6
10th	50	23rd	6
11th	12	24th	17
12th	8	25th	17
13th	16	26th	19
14th		27th	7
		28th	

CAMEL No. 2—*concl'd.*

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
28th	86	46th	
29th	42	47th	14
30th	8	48th	41
31st	19	49th	9
32nd	7	50th	28
33rd	8	51st	30
34th	5	52nd	11
35th	90	53rd	28
36th	9	54th	13
37th	18	55th	10
38th	44	56th	20
39th	6	57th	14
40th	12	58th	33
41st	8	59th	49
42nd	13	60th	41
43rd	9	61st	53
44th	30	62nd	450
45th	9	to	
46th		31st January 1920.	176 still alive.



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Fig. 1. Camel No. 2.

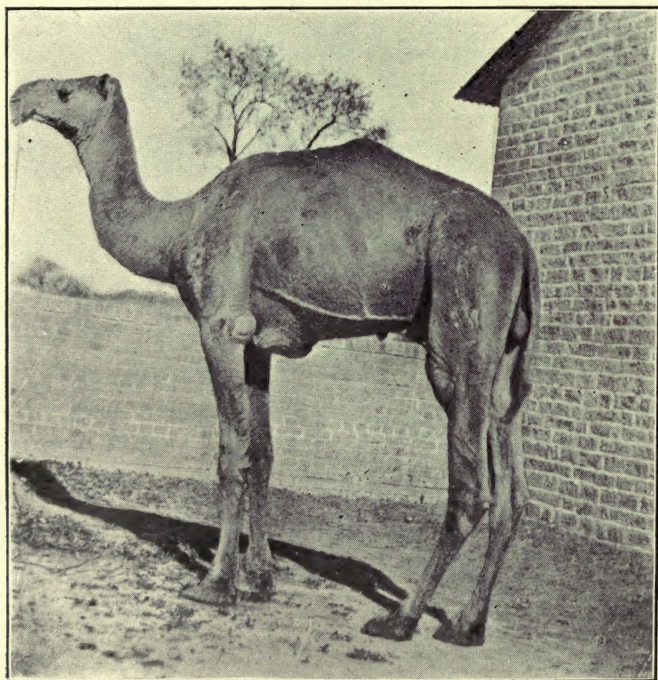


Fig. 2. Camel No. 3.
(This camel died on 4th March 1920)

Five years 3 months and 5 days under observation.

This camel kept his condition well until the last few months when he has been losing condition rapidly. During the paroxysms he was often off feed or feeding only fairly, he developed swelling and supuration of the inguinal glands and has suffered during the cold weather months from mange. It is unlikely that he will "last out" another year, as although his condition is fair he is very lifeless. (Plate I, fig. 1.)

CAMEL No. 3.

Aged 7 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st	6	19th	29
2nd	4	20th	9
3rd	6	21st	10
4th	7	22nd	9
5th	45	23rd	142
6th	8	24th	13
7th	93	25th	26
8th	9	26th	9
9th	8	27th	11
10th	1	28th	46
11th	10	29th	157
12th	19	30th	77
13th	19	31st	284
14th	7	32nd	526
15th	9	33rd	42
16th	9	34th	37
17th	6	35th	72
18th	78	36th	28 days up to 31st January 1920 alive.

Five years 3 months 5 days under observation.

This camel is still alive (31st January 1920) and has been under observation 5 years 3 months 5 days. As will be seen from the

photograph Plate I, fig. 2 the hump has disappeared and the animal is in a condition of emaciation. He fed well the whole time except when trypanosomes were present in the peripheral circulation when he was sometimes off feed or fed only fairly. His condition varied considerably, sometimes he fell off in condition then picked up again; during the last three months (cold weather) he lost condition rapidly and [will probably die within a month. During each cold weather he suffered badly from mange and developed oedema under the belly.

CAMEL No. 4.

Aged 8 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		14th	
	8		17
2nd		15th	
	20		26
3rd		16th	
	22		7
4th		17th	
	6		22
5th		18th	
	57		30
6th		19th	
	8		16
7th		20th	
	12		3
8th		21st	
	9		21
9th		22nd	
	7		18
10th		23rd	
	5		129
11th		24th	
	7		18
12th		25th	
	9		51
13th		26th	
	21		24
14th		27th	
			104
		28th	

Died 38 days after the last paroxysm.

Lived 2 years 28 days after being diagnosed to be infected with surra.

This camel developed oedema under the belly, suffered very severely from mange, was often off feed during the paroxysms, became very thin and weak and had acute diarrhoea for some days before he died.

Post mortem revealed nothing but emaciation.

CAMEL No. 5.

Aged 8 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		11th	
2nd	6	12th	105
3rd	19	13th	19
4th	22	14th	90
5th	36	15th	61
6th	9	16th	44
7th	11	17th	9
8th	11	18th	11
9th	7	19th	11
10th	12	20th	186
11th	11	21st	269

Died 9 days after the last paroxysm.

Lived 2 years 9 months 1 day after being diagnosed to be infected with surra.

This camel was the only one amongst those kept under observation that showed any pneumonic symptoms. He suffered severely from mange. Occasionally would eat earth, was periodically off feed or only

feeding fairly and in the later stages of the disease was "coughing badly." Some time before he died he had severe diarrhœa.

Post mortem : abscesses in the lungs and extreme emaciation.

CAMEL No. 6.

Aged 9 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st	} . . 80	4th	} . . 55
2nd		5th	
	} . . 23	6th	} . . 146
3rd		7th	
	} . . 14	8th	} . . 26
4th			

Died 167 days after the last paroxysm.

Lived 2 years 16 days after being diagnosed to be infected with surra.

This camel was a very fine specimen of a camel when first diagnosed to be suffering from surra. During the first six months while he was under observation he lost condition rapidly, after this the loss of condition was much slower. He suffered severely from mange and became very weak, for some time before he died he had very watery diarrhœa. He was periodically off feed or only feeding fairly.

On *post mortem* : extreme emaciation and abscess in the left kidney.

CAMEL No. 7.

Aged 9 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st	} . . 4	5th	} . . 13
2nd		6th	
	} . . 2	7th	} . . 20
3rd		8th	
	} . . 4	9th	} . . 7
4th		10th	
	} . . 52		} . . 9
5th			

CAMEL No. 7—*concl'd.*

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
10th	27	25th	9
11th	9	26th	97
12th	8	27th	50
13th	7	28th	10
14th	37	29th	7
15th	2	30th	11
16th	45	31st	28
17th	8	32nd	1
18th	9	33rd	64
19th	12	34th	44
20th	10	35th	110
21st	10	36th	44
22nd	10	37th	137
23rd	45	38th	335
24th	10	39th	90
25th		40th	

Died 120 days after the last paroxysm.

Lived 4 years 6 months 11 days after being diagnosed to be infected with surra.

Filaria were frequently seen in the blood of this camel. He had one attack of severe colic, suffered severely from mange, was periodically off feed or only feeding fairly and in the later stages of the disease lost condition rapidly.

On *post mortem* nothing abnormal with the exception of extreme emaciation.

(Search was not made for filarial parasites.)

CAMEL No. 8.

Aged 9 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st	7	16th	11
2nd	2	17th	9
3rd	7	18th	19
4th	22	19th	10
5th	15	20th	22
6th	10	21st	17
7th	8	22nd	26
8th	8	23rd	97
9th	14	24th	12
10th	18	25th	11
11th	15	26th	12
12th	5	27th	11
13th	7	28th	4
14th	8	29th	7
15th	2	30th	53
16th		31st	1
		32nd	

Died 162 days after the last paroxysm.

Lived 1 year 11 months 5 days after being diagnosed to be infected with surra.

This camel developed oedema under the belly and a short time before death, oedema of the fore legs. Enlargement and suppuration of the inqual glands was observed. He suffered from mange during the cold weather months; he gradually lost condition becoming finally so weak, that he was unable to get up without assistance. During the paroxysms he was periodically off feed or feeding only fairly.

On *post mortem* nothing abnormal with the exception of emaciation and suppuration of the inqual glands.

CAMEL No. 9.

Aged 10 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		10th	
2nd	8	11th	21
3rd	10	12th	36
4th	10	13th	64
5th	11	14th	90
6th	7	15th	61
7th	9	16th	31
8th	9	17th	27
9th	22	18th	12
10th	8	19th	93
		20th	124

Died 251 days after the last paroxysm.

Lived 2 years 6 months 3 days after being diagnosed to be infected with surra.

This camel developed slight oedema of both fore and hind legs, was periodically off feed or feeding only fairly. During the cold weather suffered from mange and lost condition gradually.

On *post mortem* nothing abnormal with the exception of extreme emaciation.

CAMEL No. 10.

Aged 10 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. or days interval between paroxysms
1st	19	11th	19
2nd	67	12th	20
3rd	6	13th	40
4th	9	14th	28
5th	10	15th	37
6th	17	16th	72
7th	2	17th	24
8th	5	18th	90
9th	8	19th	16
10th	30	20th	41
11th		21st	116
		22nd	

Died 122 days after the last paroxysm.

Lived 2 years 3 months 21 days after being diagnosed to be infected with surra.

Filaria were frequently observed in the blood of this camel. (Filaria is very common in the camel and does not appear to have a very harmful effect.) This camel was periodically off feed or feeding only fairly, became gradually weaker and weaker and for some time before death took place suffered from diarrhoea.

On *post mortem* nothing abnormal but extreme emaciation.

(Search was not made for the filarial parasite.)

CAMEL No. 11.

Aged 11 years when trypanosomes were first observed in the blood.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		13th	
2nd	15	14th	28
3rd	15	15th	59
4th	19	16th	108
5th	10	17th	19
6th	9	18th	19
7th	7	19th	17
8th	17	20th	19
9th	5	21st	14
10th	10	22nd	9
11th	18	23rd	9
12th	9	24th	25
13th	34	25th	30

Died 48 days after the last paroxysm.

Lived 1 year 8 months 12 days, after being diagnosed to be infected with surra.

This camel lost condition very rapidly, he was very frequently only feeding fairly, he became thinner and thinner and finally became so weak that he was unable to "get up" without assistance.

On *post mortem* nothing abnormal with the exception of ecci-nococcus cysts in the lungs and extreme emaciation.

II. CAMELS INOCULATED WITH SURRA.

CAMEL No. 12.

Aged 18 years when inoculated with 1 c.c. blood from camel suffering from surra.

This camel was obtained from the 52nd Silladar Camel Corps in 1915. According to the books of the Corps this camel on enlistment was 5 years old and his total length of service was over 13 years ; his age therefore was over 18 years and he was in fair condition. He was proved to be free from surra by examination of the blood and by the injection of blood into rabbits and guinea pigs which remained healthy.

He was inoculated with 1 c.c. blood from a camel suffering from surra. On the seventh day after inoculation trypanosomes appeared in the peripheral circulation and with the exception of one day, were continuously present in the peripheral circulation till he died. The camel rapidly lost condition, did not feed well and died 18 days after inoculation.

On *post mortem* nothing abnormal but emaciation.

CAMEL No. 13.

Aged 2½ months when inoculated with 1 c.c. blood from camel suffering from surra.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		12th	
2nd	4	13th	8
3rd	3	14th	6
4th	9	15th	8
5th	4	16th	28
6th	3	17th	42
7th	8	18th	45
8th	6	19th	69
9th	8	20th	9
10th	6	21st	74
11th	13	22nd	265
12th	17	23rd	58
		to	
		31st January 1920 .	193 alive

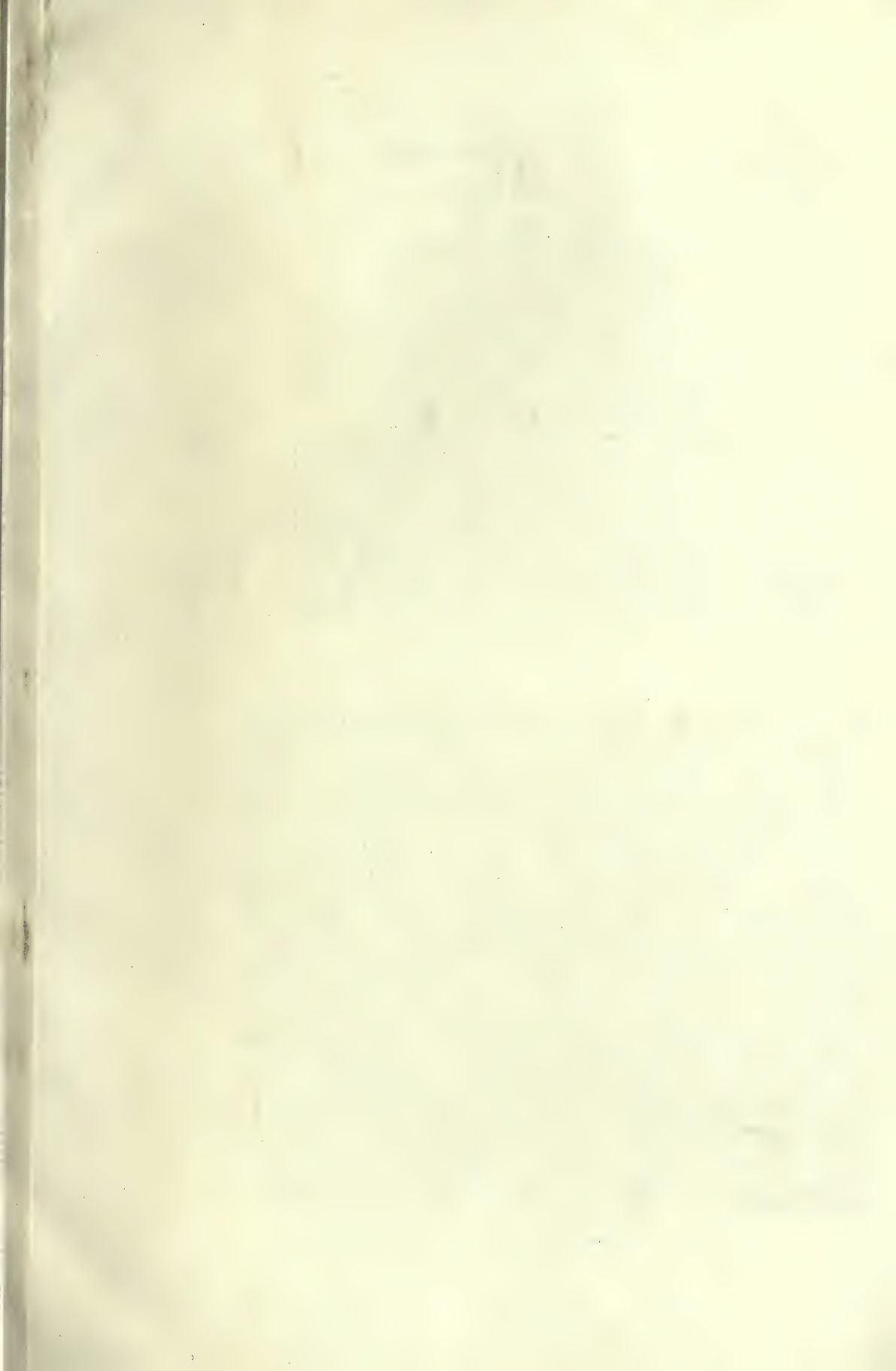




Fig. 1. Camel No. 13.

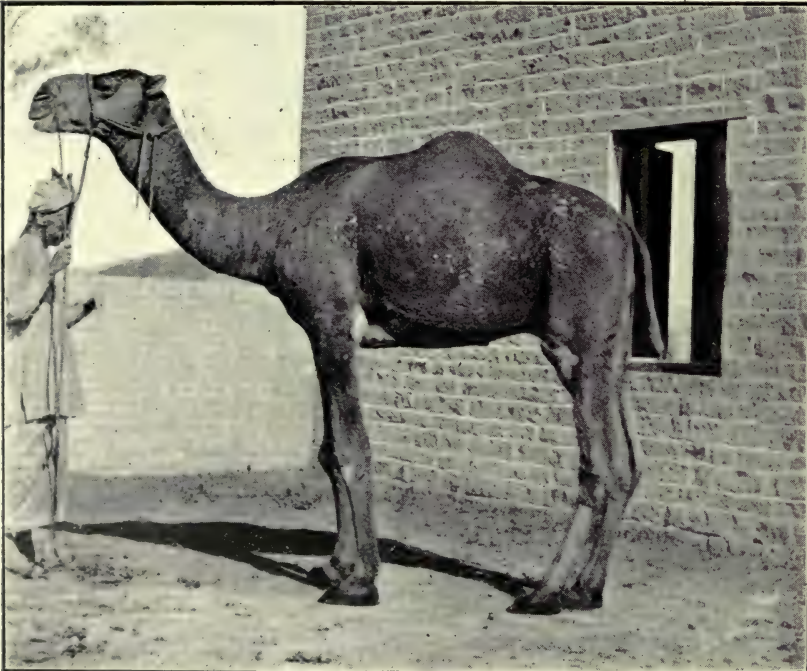


Fig. 2. Camel No. 14.

Two years 8 months 4 days under observation.

This camel was in fair condition when inoculated with surra and, though he developed camel pox, did not lose much condition. During the cold weather months has suffered from mange. He is at present in fair condition 2 years 8 months 4 days after inoculation. (Plate II, fig. 1.)

CAMEL No. 14.

Aged 1 year when inoculated with 1 c.c. blood from camel suffering from surra.

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		9th	
2nd	4	10th	9
3rd	3	11th	8
4th	3	12th	37
5th	4	13th	48
6th	15	14th	6
7th	15	15th	632
8th	7	16th	552
9th	20	to 31st January 1920 .	145 alive.

Four years 3 months 11 days under observation.

This camel was in very poor condition when inoculated with surra. During the paroxysms was sometimes off feed or fed only fairly. During the cold weather months suffered from mange and with the exception of getting urticaria, which disappeared in a few days, has shown no other symptoms. He is at present in fair condition, 4 years 3 months 11 days after being inoculated. (Plate II, fig. 2.)

CAMEL No. 15.

*Aged 1 year when inoculated with 1 c.c. blood from camel
suffering from surra.*

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		7th	
2nd	4	8th	47
3rd	6	9th	10
4th	2	10th	85
5th	4	11th	33
6th	1	12th	7
7th	5	13th	455
		14th	70
		to	
		31st January 1920	779 alive.

Four years 3 months 11 days under observation.

This camel was in very bad condition when inoculated with surra. During the paroxysms he frequently fed only fairly and sometimes was "off his feed" altogether. He suffered for a short time from dysentery, during which time he would eat earth. Swelling of the parotid gland was noticed, but after 18 days the swelling disappeared. During the cold weather months suffered from mange. He improved in condition and is now in fair condition, 4 years 3 months 11 days after being inoculated. (Plate III, fig. 1.)



Fig. 1. Camel No. 15.



Fig. 2. Camel No. 16.

CAMEL No. 16.

*Aged 1 year when inoculated with 1 c.c. blood from camel
suffering from surra.*

Paroxysms	No. of days interval between paroxysms	Paroxysms	No. of days interval between paroxysms
1st		14th	
2nd	8	15th	11
3rd	27	16th	56
4th	38	17th	62
5th	15	18th	55
6th	1	19th	23
7th	18	20th	55
8th	8	21st	9
9th	146	22nd	36
10th	23	23rd	21
11th	46	24th	12
12th	10	25th	25
13th	26	26th	103
14th	17	27th to 31st January 1920	186 519 alive

Four years 3 months 11 days under observation.

This was a female camel and when inoculated with surra was in very poor condition. During the time this animal has been under observation with exception of periodically "feeding fairly" and suffering from mange during the cold weather months, no other symptoms developed.

She is now in fair condition, 4 years 3 months 11 days after being inoculated. (Plate III, fig. 2.)

SUMMARY OF CAMELS INFECTED WITH SURRA (NATURALLY ACQUIRED).

Camel No.	Age when diagnosed	Time under observation			Result
		Y.	M.	D.	
1	Years 6	4	11	20	Died.
2	6	5	3	5	Alive, condition fair.
3	7	5	3	5	*Alive, condition very poor.
4	8	2	0	28	Died.
5	8	2	9	1	Do.
6	9	2	0	16	Do.
7	9	4	6	11	Do.
8	9	1	11	5	Do.
9	10	2	6	3	Do.
10	10	2	3	21	Do.
11	11	1	8	12	Do.

SUMMARY OF CAMELS INOCULATED WITH SURRA.

12	18	0	0	18	Died 18 days after inoculation.
13	2½ months	2	8	4	Alive, condition fair.
14	1 year	4	3	11	Do.
15	1 "	4	3	11	Do.
16	1 "	4	3	11	Do.

* This camel died on 4th March 1920.

Remarks.

1. Out of the 11 camels that had been naturally infected with surra, only two are still alive ; of these 2, one is at the point of death and the other is losing condition rapidly.

The time a surra-infected camel lives probably depends to a great extent upon the age of the camel when he became infected.

In the case of the camels artificially inoculated with surra, the 18 year old camel showed very little resistance to the disease compared to the four very young camels, which showed very great resistance and they may recover.

2. It is unlikely that camels that become infected with surra after six years of age and are worked ever recover from the disease ; whether those that become infected when very young, recover, remains to be ascertained.

3. In the early stages of surra the paroxysms, in the majority of cases, are far more frequent than in the later stages.

4. Diarrhoea is a frequent symptom in the later stages of the disease.
5. Mange produces very rapid loss of condition in surra-infected camels.
6. Swelling and suppuration of the inuinal glands is frequently seen in surra-infected camels.
7. Surra-infected camels when stall-fed often feed well even during the paroxysms, but if out browsing during the paroxysms they do not browse well, they "hang about" and do not go from tree to tree like a camel in normal health, they can at once be seen to be sick.
8. Oedema of the belly and legs is sometimes seen in camels suffering from surra.

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